AL-AZHAR
Dental Journal
For Girls

The Official Publication
of The Faculty of Dental
Medicine For Girls,
Al-Azhar University
Cairo, Egypt.

Print ISSN 2537-0308 • Online ISSN 2537-0316

ADJ-for Girls, Vol. 5, No. 2, April (2018) — PP. 129:134

Clinical and Laboratory Evaluation of the Efficacy of Three Different Treatment Modalities in Management of Dentin Hypersensitivity

Asmaa A. Mosleh[1], Maha A. Niazy[2] *and* Mohamed A. El-yassaky[3]

Codex : 15/1804

azhardentj@azhar.edu.eg

http://adjg.journals.ekb.eg

ABSTRACT

Objectives: - *This* study was conducted to evaluate the clinical and laboratory effect of three different treatment modalities in management of dentin hypersensitivity.

Materials and methods: one hundred- twenty samples were used in the study procedures, for dentin permeability test and Scanning Electron Microscopic examination (SEM). The samples were randomly divided into two groups **Group A_1**, totally removed smear layer **Group A_2**, partially removed smear layer. Each group was further subdivided into four subgroups according to the treatment agent applied: ammonium hexafluorosilicate (SiF) gel, propolis extract, Curodont D'senz and the control group that were left untreated. One hundred and five (105) hypersensitive teeth were enrolled for this study. The subjective assessment of dentin hypersensitivity was done before application of the agent (baseline) then immediate, 1 week, 2 weeks, 4 weeks and 3 months respectively. Patients were asked to rate their perception to tactile, air and cold stimuli by using Verbal Rating Scale (VRS) and Visual Analogue Scale (VAS). ***Results:*** Permeability results revealed that there were high statistical significant difference between the study groups with lowest statistically significant mean depth of dye penetration values were found with propolis treated samples. The results of the clinical study revealed that there was high significant difference between pain scores before and after treatment for all tested groups. ***Conclusion:*** Propolis extract, Curodont D'senz and SiF gel were effective in reducing dentin permeability, occluding dentinal tubules and alleviating the hypersensitivity symptoms, with propolis extract paste being the most effective within 1 to 2 weeks and sustained up to 3 months.

KEYWORDS

Ammonium Hexaflurosilicate,
Propolis extract,
Curodont D'senz,
VRS And VAS.

A paper extracted from Doctor's Thesis entitled " Clinical and Laboratory Evaluation of the Efficacy of Three Different Treatment Modalities in Management of Dentin Hypersensitivity"

1. Assistant Lecturer of Operative Dentistry, Faculty of Dental Medicine for Girls, AL-Azhar University.
2. Professor of Operative Dentistry, Faculty of Dental Medicine for Girl's, AL-Azhar University.
3. Professor of Operative Dentistry and Dean of Faculty of Dental Medicine Sinai, University.

INTRODUCTION

Dentinal hypersensitivity is a common clinical condition which affects between 8 to 35% of the population. There is a consensus that sensitivity arises from fluid movement within the tubules stimulating mechanoreceptors on the pulpal nerves as stated by hydrodynamic dynamic theory of Brannstrom. No completely reliable treatment has been put forward for dentinal hypersensitivity. An agent can be of benefit in one case and fail in another. Due to the fact that dentine sensitivity is a very prevalent condition, a variety of symptomatic treatments exist. The requirements for an ideal treatment for dentin sensitivity were listed by Grossmann in 1935. Search for an ideal agent still continues [(1)].

Fluoride has been widely used for the treatment of dentin hypersensitivity. The representative fluoride agents applicable for treatment of dentin hyperensitivity is diamine silver fluoride [AgF: (NH3)2AgF] which is widely used in dental clinics in Japan. However, AgF causes tooth discoloration, especially problematic with regard to permanent teeth. Ammonium hexafluorosilicate [SiF: $(NH4)_2SiF_6$] was subsequently prepared in order to overcome tooth discoloration caused by treatment with AgF [(2)]. Silica was employed in SiF compounds instead of silver to avoid staining of teeth and to occlude open dentin tubules with a silica–calcium phosphate precipitate in simulated oral environment. Therefore, SiF solution showed a strong potential for use in dentin hypersensitivity treatment[(3-4)].

Although fluoride's contribution in treating dentin hypersensitivity is sufficiently justified, the agent appears to be inadequate to surpass high caries challenge in many individuals, a situation that highlights the need to find new strategies.

Natural products have been used for thousands of years in folk medicine for several purposes. Among them, propolis a bee product has attracted increased interest due to its harmless nature and innumerable biological activities. The word propolis is derived from the greek word ''pro'' before and ''polis'' city or the defender of the city [(5)]. Propolis is a resinous yellow brown to dark brown substance collected by honey bees from sprouts, exudates of trees and other parts of plants and modified in the beehives by addition of salivated secretions and wax. It is used by bees for protection, to repair openings and damages in hives, to construct aseptic places for queen egging and to embalm killed invaders [(6)]. It has been shown to have antimicrobial, antitumor, anesthetic, anti-inflammatory, antiviral, and healing properties[(7)].

A synthetic, self-assembling peptide (P_{11}-4) is used for biomimetic mineralization and dentinal tubule occlusion for the treatment of dentin hypersensitivity [(8)]. P_{11}-4 (Oligopeptide 104) consists of the natural occurring amino acids Glutamine, Glutamic acid, Phenylalanine, Tryptophan and Arginine. The resulting higher molecular structure has a high affinity to tooth mineral [(9)]. It builds a 3D bio-matrix with binding sites for Calcium-ions serving as nucleation point for Hydroxyapatite (tooth mineral) formation. In a number of in vitro and in vivo experiments, the assembled P_{11}-4 fibers were shown to be highly biocompatible with low immunogenicity [(10)]. Therefore, the present study aimed at evaluating and comparing the clinical and laboratory effect of three different treatment modalities in management of dentin hypersensitivity.

MATERIALS AND METHODS

Preparation of Ammonium hexafluorosilicate (SiF) gel:

100 ml SiF gel with 100 ppm fluoride concentration was prepared by successive addition, heating and stirring of distilled water, 5 gm of cellulose gum powder (HPMC), SiF solution and cold distilled water, respectively [(11)].

Preparation of Propolis extract paste:

0.200 grams of propolis powder was prepared into a paste through mixing with 0.2 ml of Ethyl Alcohol (70%). The paste was freshly prepared just prior to its use [(12)].

Specimens grouping:

Fifty intact human lower premolars extracted for orthodontic reasons were used in this study. Forty teeth were used to prepare 80 samples for dentin permeability "dye penetration" test and additional (10) teeth were used to prepare (40) samples that were used for Scanning Electron Microscopic examination (SEM). Samples were randomly divided into two main groups. **Group A_1**, totally removed smear layer **Group A_2**, partially removed smear layer. Each group was further subdivided into four subgroups of samples, according to the treatment agent applied: **B_1** treated with ammonium hexafluorosilicate gel, **B_2** treated with propolis extract paste, **B_3** treated with Curodont D'senz and **B_4** representing the control group that were left untreated.

Specimens preparation:

Preparation of specimens for dentin permeability (dye penetration) test:

Forty teeth were used for dye penetration test. Each tooth was sectioned longitudinally, in mesiodistal direction, into two parts (buccal and lingual). Cavities of 0.8 mm depth and 2 mm width were prepared on the cervical region 1mm coronal to the gingival line. Prior to the treatments halve the samples were treated with 37% phosphoric acid gel for 30 seconds. Acid was then rinsed and reapplied for 3 minutes, representing maximum dentin permeability. While the other halve were treated with the same acid gel for 15 seconds,representing minimum dentin permeability "dentin sensitivity" [13, 14]. Treatments were topically applied to the cavities of the samples according to their division.

Selection of patients:

One hundred and five (105) hypersensitive teeth in fifteen (15) patients were enrolled for this study. Patients' age ranged from (20-40) years old. Inclusion criteria included presence of a minimum of four hypersensitive teeth in each patient, teeth recorded a discomfort score of two or more to tactile, cold and air stimulation, teeth having hypersensitivity only on the facial aspect and patients' willingness to participate in the study. The exclusion criteria included patients with any medical or dental condition that could impact the study results during its expected length, history of drug addictions and use of potent analgesic and/ or anti-inflammatory drugs [15].

Clinical procedures:

Patients were divided into three groups. Group A1: teeth were treated with SiF gel, group B2: teeth were treated with propolis extract and group C: teeth were treated with curodont D'senz. The subjective assessment of dentin hypersensitivity was done before application of the agent (baseline) then immediate after treatment, 1 week, 2 weeks, 4 weeks and 3 months respectively. Subjects were asked to rate their perception to tactile, air and cold stimuli by using VRS and VAS [16].

RESULTS

(Table 1 and 2) and (Figure 1a-c)

Permeability results showed that there were high statistical significant difference between the study groups in both dye penetration test (table 1) and scanning electron microscope examination (figure 1a-c). The results of the clinical study revealed that there was high significant difference between pain scores before and after treatment for all tested groups. Curodont and SiF group the needed four applications for complete relief while Propolis group needs only 2 applications (table 2).

Table (1): The mean, standard deviation (SD) values and results of One-way ANOVA test for comparison of the mean dye penetration depth among the three treatment modalities.

Smear layer	SiF		Propolis		Curodont		P-Value
	Mean	SD	Mean	SD	Mean	SD	
Totally removed (A_1)	714.2^a	35.3	212.63^c	19.3	449.4^b	22.3	0.001*
Partially removed (A_2)	144.3^a	6.7	27.31^c	3.45	71.8^b	8.65	0.000*

**: Significant at $P \leq 0.05$*

Table (2): *Mean & standered deviation values (SD) using Analysis of Variance (ANOVA) and Post-hoc test for comparison between VAS in the three tested groups.*

Application	SiF A		Propolis B		Curodont C		P-value
	Mean	SD	Mean	SD	Mean	SD	
Before treatment	6.2	1.35	6.6	1.4	6.4	1.3	0.464
Immediate after treatment	4.9_b	1.33	3.1_a	1.2	4.7_b	1.4	0.000*
After 1 week treatment	3.9_c	1.02	0.8_a	0.7	2.8_b	1.2	0.001*
After 2 weeks treatment	2.5_c	0.9	0.2_a	0.41	1.5_b	0.8	0.000*
After 4 weeks treatment	1.03_c	0.3	0_a	0	0.4_b	0.1	0.001*
After 3 months treatment	0	0	0	0	0	0	

** Significant at P≤0.05, a and b the same letter indicates no significant difference at α= 0.05 by tukey's multiple comparison test.*

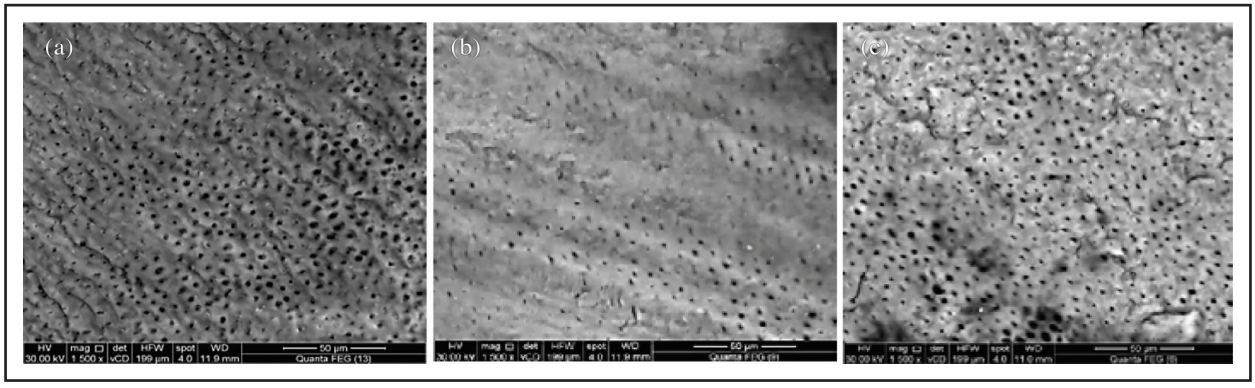

Fig. (1) SEM photomicrographs of different groups a) SiF, Totally removed smear layer, b) Propolis Totally removed smear layer, c) Curodont Totally removed smear layer.

DISCUSSION

Dentin hypersensitivity is one of the most painful and least successfully treated chronic problems of the teeth. It is one of the common complaints and has been reported that as many as one in every seven patients undergoing dental treatment experiences this painful condition [17]. A wide array of treatment modalities is available for the management of dentin hypersensitivity. The desensitizing agents are applied either by the dentist (in office treatment) or used by the patient as home application.

Home applications are mainly in the form of dentifrices and also as mouthwashes. The effects of home-applied agents are manifested after a period of time and would require a considerable degree of patient compliance. In office treatment modalities provide instantaneous relief to the patient, but the effects are often temporary. Thus, none of the treatment modalities has been able to provide a permanent relief from dentin hypersensitivity [18]. Taking these facts into consideration, there is a need to develop treatment approaches which permit the relief of the symptoms of dentin hypersensitivity.

Ammonium hexafluorosilicate [SiF: $(NH_4)_2SiF_6$] was selected for this study, since this fluoride compound in particular was found in several previous studies to provide an optimal dentinal tubule occlusion with reduction of dentin permeability and subsequent relief of dentin hypersensitivity and provide the highest effect than the other previously introduced fluoride compounds [2, 3]. Recently, researchers have drawn their attention to SiF, which does not change tooth color and induces apatite formation and mineralization by silicate. [19] Dentinal tubules were occluded homogeneously and completely with silica–calcium phosphate precipitation after SiF solutions treatment, and it had a continuous effect on dentinal tubule occlusion under a simulated oral environment [20].

The search for a natural desensitizing agent with long lasting effects has led to the observation that Propolis had promising effects on dentin hypersensitivity [6, 12]. Also, it was observed that propolis has an anti-inflammatory action; it stimulates reparative dentin formation which would be able to reduce dentin permeability. Some in vitro studies have successfully shown that, propolis has clinically significant effect on reduction of dentin permeability, [21] but to date, there have been very few studies done on desensitizing effect of propolis in vivo. Curodont D' Senz is a product that incorporates the P_{11}-4-based Curolox technology, together with fluoride, and calcium phosphate, for relief of dentin hypersensitivity. It was shown that peptide treatment significantly increased net mineral gain due to a combined effect of increased mineral gain and inhibition of mineral loss. In addition, the self-assembling peptide (P_{11}-4) was shown to induce hydroxyapatite nucleation de novo [22]. P_{11}-4 is a rationally designed self-assembling peptide. This class of peptides undergoes a hierarchically predetermined process of assembling, forming fibrillar three-dimensional scaffolds in response to specific environmental factors [23]. It is claimed that, when the gel is applied to the tooth, peptides diffuse into the subsurface micropores and form a 3D scaffold made of small fibers, enhancing hydroxyapatite crystallization for a period of three months [24,25].

The clinical results revealed that propolis extract treated group provided the lowest mean VRS scores immediately after treatment, after 1, 2, 4 week at probing, air and cold stimuli and VAS. Propolis thus had an immediate as well as increased sustained effect. The immediate relief could be due to its tubular sealing effect which prevents the flow of the dentinal fluid in the tubules, thereby preventing any alteration in the arrangement of the odontoblastic process and nerve endings. The long lasting of effect of Propolis probably could be due to stable nature of the deposits so formed. As with all in-office treatments, the persistence of tubule occlusion is the important parameter. The deposits formed by propolis were little influenced by rotation in artificial saliva. This would attest to the apparent strong affinity of deposits for dentine and possible could be the cause of lasting relief from dentine hypersensitivity [1]. The retention and stability of the Propolis deposits in hostile oral environment needs further investigation and is not within the scope of this study.

CONCLUSION

Propolis extract, Curodont D'senz and ammonium hexaflurosilicate gel were effective in reducing dentin permeability, occluding dentinal tubules and alleviating the hypersensitivity symptoms, with propolis extract paste being the most effective within 1 to 2 weeks and sustained up to 3 months.

REFERENCES

1. Purra RA and Mushtaq M. Scanning electron microscopic evaluation of the desensitizing effect of propolis in the dentine disc model: An in-vitro study. Inter J Dental Clin. 2012; 4(3): 6-9.
2. Murata H, Ishikawa K, Tenshin S, Horiuchi S, Nakanishi M, Asaoka K, et al. Fluoridation of hydroxyapatite powder by ammonium hexafluorosilicate. Caries Res. 1996; 30: 465-70.
3. Suge T, Kawasaki A, Ishikawa K, Matsuo T and Ebisu S. Effect of ammonium hexafluorosilicate on dentin tubule occlusion for the treatment of dentin hypersensitivity. Am J Dent. 2006; 19: 248-52.
4. Suge T, Kawasaki A, Ishikawa K, Matsuo T and Ebisu S. Ammonium hexafluorosilicate elicits calcium phosphate precipitation and shows continuous dentin tubule occlusion. Dent Mater. 2008; 24:192-8.
5. Almas K, Mahmoud A and Dahlan A. A comparative study of porpolis and saline application on human dentin: A SEM study. Indian J Dent Res. 2001; 12: 21-7.
6. Sonmez S, Kirilmaz L, Yucesoy M, Yücel B and Yilmaz B. The effect of bee propolis on oral pathogens and human gingival fibroblasts. J of ethnopharmacology. 2005; 102(3): 371-6
7. Brunton PA, Davies PW, Burke JL, Smith A, Aggeli A, Brookes J, et al. Treatment of early caries lesions using biomimetic self-assembling-peptides - a clinical safety trial. Brit Dent J. 2013; 215(E6): 1-6.
8. European Commission database with information on cosmetic substances and ingredients. Oligopeptide 104. 2015.
9. Kirkham J, Firth A and Vernals D. Self-assembling peptide scaffolds promote enamel remineralization. J Dent Res. 2007; 86: 426-30.
10. Wen HB, Moradian-Oldak J, Leung W, Bringas P and Fincham AG. Microstructure of an amelogenin gel matrix. J struct Biol. 1999; 126: 42-51.
11. Abd-Allah FI, Dawaba HM and Ahmed AM. Preparation, characterization, and stability studies of piroxicam-loaded microemulsions in topical formulations. Drug Discov Ther. 2010;4(4):267-275.
12. Mehta P, Vimala N and Mandke L. An insight into dentin desensitizing agents: in vivo study. Indian J of Dent Res. 2013; 24(5): 571-4.
13. Sales-Peres S , ReinatoJ, Sales-Peres A and Marsicano. Effect of Iron Gel on Dentin Permeability. Braz Dent J. 2011; 22(3): 198-202.
14. Gateva N, Gusyiska A, Stanimirov P and Kabaktchieva R. Effect of etching time and acid concentration on micromorphological changes in dentin of both dentitions .J of IMAB. 2016; 22(2): 1099- 110.
15. Torwane NA, Hongal S, Goel P, Chandrashekar BR, Jain M and Saxena E. A clinical efficacy of 30% ethenolic extract of Indian propolis and Recaldent in management of dentinal hypersensitivity: A comparative randomized clinical trial. Eur J of Dent. 2014; 7(4): 461-8.
16. Verma P, Gupta U, Dodwad V, Kukreja B and Arora K. Evaluation of the clinical efficacy of a new desensitizing tooth paste containing nano-crystalline hydroxyapatite in dentin hypersensitivity patients: A double blind randomized controlled clinical trial. J Dent Spec. 2013; 1: 47-54.
17. Porto IC, Andrade AK and Montes MA. Diagnosis and treatment of dentinal hypersensitivity. J Oral Sci. 2009; 51: 323-32.
18. Purra AR, Mushtaq M, Acharya SR and Saraswati V. A comparative evaluation of propolis and 5.0% potassium nitrate as a dentine desensitizer: A clinical study. J Indian Society Periodont. 2014; 18(4): 466-71.
19. Sgolastra F, Petrucci A, Severino M, Gatto R and Monaco A. Lasers for the treatment of dentin hypersensitivity: a meta-analysis. J Dent Res. 2013; 92:492-9.
20. Suge T., Shibata S. and Matsuo T. Effects of ammonium hexafluorosilicate concentration on crystallinity of hydroxyapatite powder. International Association of Dental Research. 2010: 67: 35-40.
21. Sales-Peres S, Carvalho F, Marsicano J, Mattos M, Pereira J, Forim M, et al. Effect of propolis gel on in vitro reduction of dentin permeability. J of Applied Oral Sci. 2011; 19(4): 318-23.
22. Kirkham J, Brookes SJ, shore RC, wood SR, smith DA, zhang J, et al. Physico-chemical properties of crystal surfaces in matrix mineral interactions during mammalian biomineralization. Curr Opin Colloid Interface Sci. 2002; 7: 124- 32.
23. Dong, Z, Chang, J, Deng, Y and Joiner, A. Tricalcium silicate induced mineralization for occlusion of dentinal tubules. Aust. Dent. J. 2011; 56, 175-80.
24. Maude S, Tai LR and Davies RP. Peptide synthesis and self-assembly. Top Curr Chem. 2012; 310:27-69.
25. Broseler F and Tietmann C. Effect of Curodont Repair in patients with buccal carious lesions: a mono-centre, singleblinded, randomised, controlled, split-mouth study-intermediate report. Clin Oral Investig. 2013;17: 1055.